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SADR Series Capacitive Accelerometer Sensor (3 Aixs)

User Manual

Overview

The SUCH-SADR series 3-axis capacitive accelerometer sensors are manufactured using imported silicon micro-mechanical variable capacitance sensing elements, with a frequency response range starting from DC up to over 1000 Hz. As a result, they can be used to measure dynamic and static accelerations, such as vibration, impact, gravitational acceleration, or tilt.

The sensor's sensitive element is a cantilever beam structure, enabling it to achieve a nonlinear error of less than 0.5% within the corresponding linear acceleration ranges of ±1g, ±5g, ±10g, ±50g. Installation methods include bolted mounting or adhesive bonding, making it extremely convenient to use. It is widely applicable for measurement, calibration, and industrial monitoring of vibration, impact, rotational acceleration, and inclination. Capacitive acceleration sensors have the following characteristics:

- 3-axis output
- Can measure static acceleration, such as gravitational acceleration and tilt angle
- High sensitivity and stable performance
- Low voltage, low current, and low power consumption
- Small size, light weight, and easy installation
- Strong anti-interference capability

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Technical Specifications

When selecting a sensor, users should pay attention to the measurement range. The measurement range selection is based on the following table:

Model	**SADR301**	**SADR305**	**SADR350**
Rang	±1g	±5g	±50g

Model	SUCH-SADR301	SUCH-SADR305	SUCH-SADR350
Sensitivity	1000 mV/g (3 axis)	200 mV/g (3 axis)	38 mV/g (3 axis)
Measurement Range (Peak)	±1g	±5g	±50g
Maximum Lateral Sensitivity	<5%	<5%	<5%
Frequency Response (-3dB)	0～800 Hz	0～800 Hz	0～400 Hz
Nonlinearity	<0.5%	<0.5%	<0.5%
Operating Temperature Range	-40°C to +120°C	-40°C to +120°C	-40°C to +105°C
Shock Limit (No Power Supply)	5000 g	5000 g	4000 g
Sensitivity Temperature Coefficient	0.3 %/°C	0.02 mV/°C	0.8 %/°C
Zero g Bias Voltage Temperature Coefficient	—	0.2 mV/°C	—
Noise	<45 μg/√Hz	<100 μg/√Hz	1.4 mg/√Hz
Output Impedance	<100 Ω	<100 Ω	<100 Ω
Power Supply	+6～+16 VDC	+6～+16 VDC	+6～+16 VDC
Operating Current	≤5 mA	≤5 mA	≤5 mA
Zero g Bias Voltage	2.5 ± 0.1 V	2.5 ± 0.1 V	2.5 ± 0.1 V
Mounting Method	4 ϕ2.8 holes	4 ϕ2.8 holes	4 ϕ2.8 holes
Housing Material	Aluminum alloy	Aluminum alloy	Aluminum alloy
Weight	20 g	20 g	30 g
Cable	Five-core shielded cable		
Output Definition	Red wire: Positive power supply		
	White wire: Ground		
	Yellow wire: X-axis output		
	Blue wire: Y-axis output		
	Green wire: Z-axis output		
Accessories	Sensor certificate of conformity (calibration parameters, frequency response curve)		
	Four M2.5×25 screws		

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Working Principle

Capacitive accelerometer sensors utilize micro-machining technology to fabricate variable-gap differential capacitive sensing elements on a silicon wafer. As shown in the figure below, the differential capacitor consists of two fixed plates and a movable plate, with the movable plate connected to an inertial mass block, i.e., the cantilever beam depicted in the figure. The movement of the cantilever beam causes changes in the differential capacitance, which are then amplified, converted, and detected by integrated circuits on the same silicon wafer, resulting in an output voltage signal proportional to acceleration.

The SADR series capacitive accelerometer sensors require a single power supply of at least +5V or +3V DC to facilitate interfacing with standard data acquisition systems. Their sensitivity and DC bias voltage value at 0g are both proportional to the power supply voltage. When subjected to positive acceleration, the output voltage gradually increases from the 0g output value; when subjected to negative acceleration, it gradually decreases. When subjected to acceleration, the DC output voltage value is:

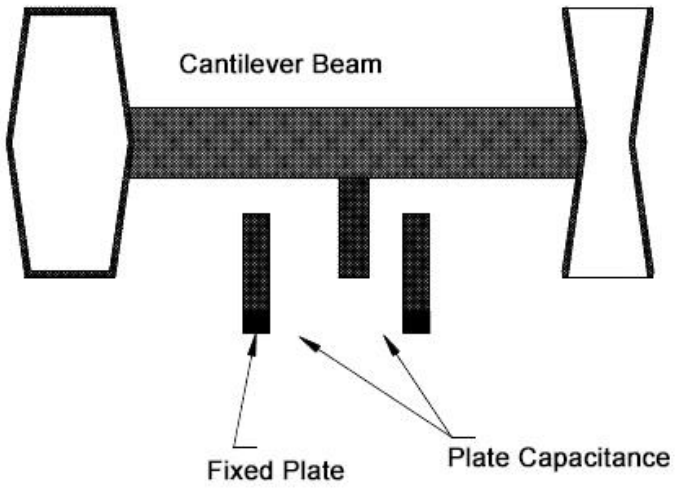
$$\mathbf{V_{out} = Vs/2 + (sensitivity \times a \times Vs/5)}$$

where Vs is the power supply voltage, in volts (V)

a is the acceleration value, in g

The AC voltage output value is:

$$\mathbf{V_{out} = sensitivity \times a}$$



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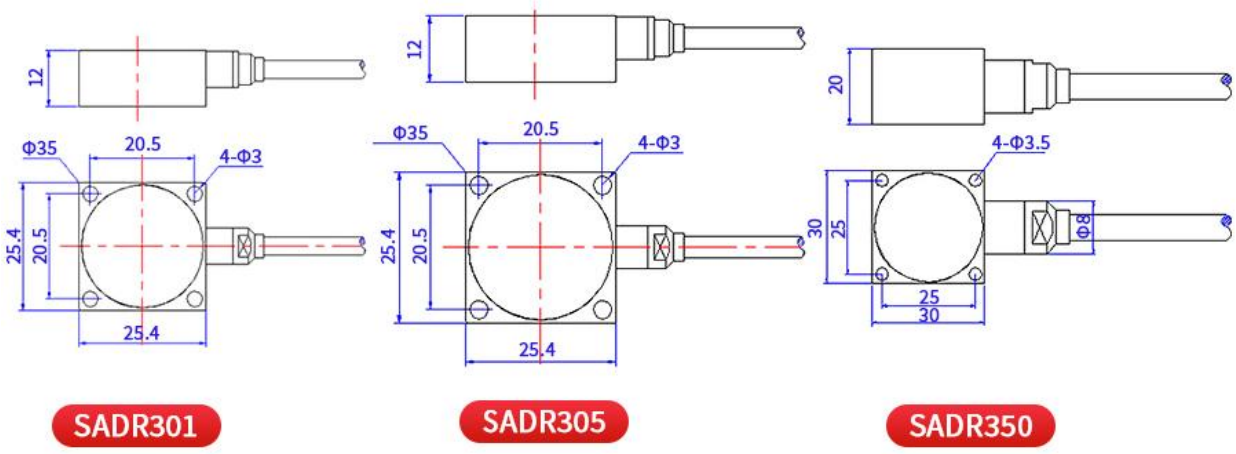
Structural Features

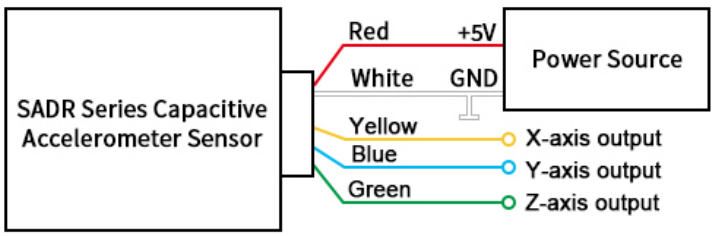


The SADR series capacitive accelerometers utilize a differential capacitive sensing element, whose output voltage depends on the tilt angle relative to gravity. The sensor's tilt angle output is determined by the magnitude of gravity parallel to the sensor. This principle is employed to measure the tilt angle. When measuring angles greater than 10°, the following formula should be used for calculation:

SINα = SIN[(output voltage at the measured tilt angle - 0g DC bias voltage)/sensitivity]
For tilt angles less than 10°, the value can be directly calculated as an arc degree value using the following formula:

α = [(output voltage at the measured tilt angle - 0g DC bias voltage)/sensitivity] × (180/π)

Our company has designed the SADRTLO adjustable amplifier to complement the SADR series capacitive accelerometers. It provides a +5V power supply with amplification and low-pass filtering functions, which can reduce the measurement bandwidth and improve resolution. It can also be powered by a battery, making it very convenient to use.
The sensor wiring method is as follows:



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When using the sensor, please note the following precautions:

1. Avoid using high voltage to prevent damage to the sensor. The sensor has a maximum shock resistance of 1000g. Users should avoid subjecting the sensor to excessive shocks during use or storage to prevent irreparable damage.
2. Installation can be done using bolts for rigid connection or adhesive for fixation. When installing, please pay attention to the direction of vibration and shock.
3. The cable is 2 meters long and can be customized according to user requirements. Users should pay attention to the wiring method when connecting the cables.
4. The sensor is generally calibrated once a year and comes with a six-month warranty.

Accessories

- Capacitive accelerometer sensor x1
- Certificate of conformity
- Bolts: M2.5*25 x4